Ch-6 Flowering Plant Anatomy

Cells → Tissue → Tissue System → organ → organ system → Plant

Tissue → Meristematic tissue; Permanent tissue (Differentiated cells)

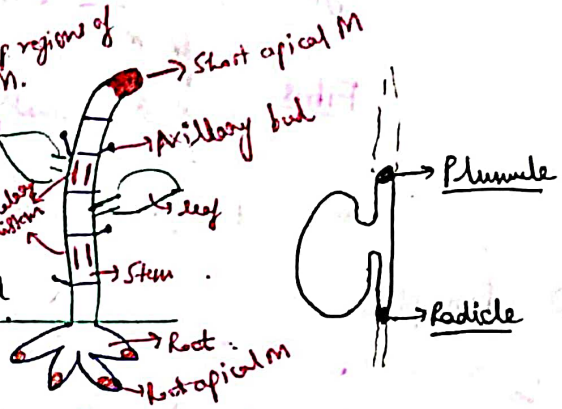
Tissue System → Vascular, Ground, Epidermal

organ: leaf, stem, root; flower

1. The Tissue

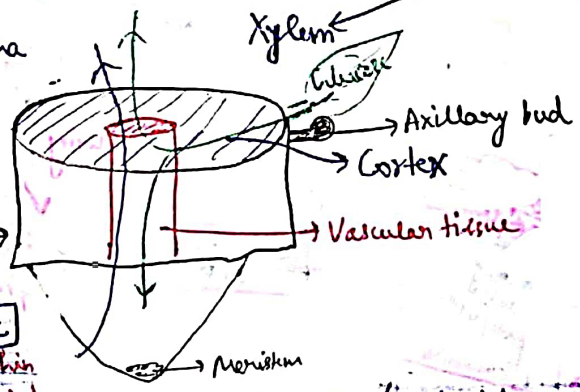
a) Meristematic tissue

- Primary Meristem → form 1° plant body [that from beginning]
  - ① Shoot apical & Root apical Meristem → Produce 1 Tissue
  - ② Axillary buds (cells left behind during shoot growth, may form axillary shoot from shoot apical M.)
  - ③ Intercalary Meristem: eg. in Grasses → Regenerate grazed part
- 2° Meristem / lateral Meris. [formed later on from permanent tissue] → Cork Cambium, Vascular Cambium
  - 2°/lateral M. → ① Produce woody axis ② Cylindrical M.



b) Permanent Tissue

- 1. Simple (only one type of cell)
  - Parenchyma (Most abundant)
  - Collenchyma
  - Sclerenchyma
- 2. Complex (many type of cells in tissue)
  - Xylem
  - Phloem



1. Simple permanent Tissue :-

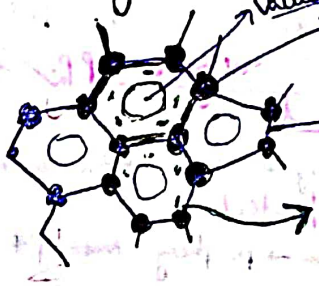
a) Parenchyma :- Living; Thin cell wall (1°); Isodiametric / Oval, spherical, polygonal, elongated; Thin wall; Closely packed / small intercellular spaces

- Funct^{n} → Photosynthetic
- Secret^{n} → Resin, Tannin, Gums → Storage

b) Collenchyma :- Living; provide mechanical support to growing parts eg. Young stem, petiole of leaf

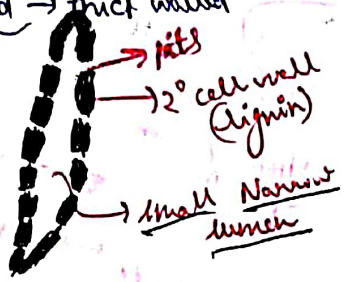
- Thickened corner [Cellulose + Hemi-cellulose + Pectin] → 1° cell wall
- Often have chloroplasts → do P.S.
- → Below epidermis in dicots (stem)
- → Found in homogeneous layer/patches
- → Cells Oval, spherical, polygonal.

NCERT



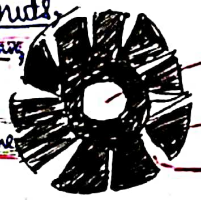
c) Sclerenchyma :→ Dead → 2° cell wall of Lignin & having pits.
(without protoplast) → long, Narrow.

Fibres
→ elongated → pointed → thick walled
→ occur in gps.



Fibre

Sclereids → spherical, oval, cylindrical
→ Narrow cavities
→ eg in fruit walls of nuts, pulp of fruits like guava, pear, sapota, seed coat of legume, leaves of tea.



Sclereid

→ For Mechanical support of organs.

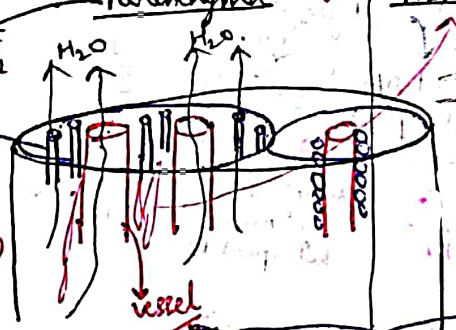
2. Complex : a) Xylem → Mostly Non-living

Vessels – dead
Multicellular, broad lumen
Parenchyma
Tubes.
2° wall of lignin
pits
For intercellular connect
Large central cavity
Perforation in common walls

Tracheids – dead
Narrow lumen, fusiform, closed end, elongated tube like
pits
fusiform

Parenchyma – living
Living, thin walled
Storage, secretion
Storage of Starch, fat, Tannins

Fibres – dead
Septate / aseptate



Xylem → Mechanical support to plant

Radial Conduction of H_2O :→ By Ray Parenchymatous cell.

* Xylem Vessel → Not in Gymnosperm.

b) Phloem → Mostly living

Sieve (living) Tubes
Pit field in transverse wall
Peripheral cytoplasm
Nucleus (absent)
very less protoplasm
big vacuole
No nucleus
Sieve plates
Companion cell → Maintains pressure gradient inside sieve tube elements.

Companion cells – living
Specialised parenchymatous cells

Ph. parenchyma – living
Stores food + Resin, + latex, + mucilage
RMC college

Ph. fibres – dead
best fibres
Flax, Hemp, jute fibres → Used
Tapering, slightly dense cytoplasm & Nucleus.
Plasmodesmatal connection exist b/w cells through pits in cell wall
→ Schizogenously - retorse j.
→ Tapering
→ Generally Absent in Monocot, Present in 2° phloem

Gymnosperm
* Sieve cells, * Albuminous cells

Angiosperm
* Sieve tube + Companion cells

Monocot
Phloem parenchyma absent

Dicot
P. P. present

* 1° xylem → Protoxylem (first formed)
→ Metaxylem [later formed]
(Not 2° xylem)

Stem → Endarch → Protoxylem → pith, Metaxylem → periphery
proto to protect

Root → Exarch → protoxylem → periphery, Meta → pith

* Proto phloem → Narrow Sieve tubes Meta phloem → Bigger Sieve tubes.
→ I° phloem ←

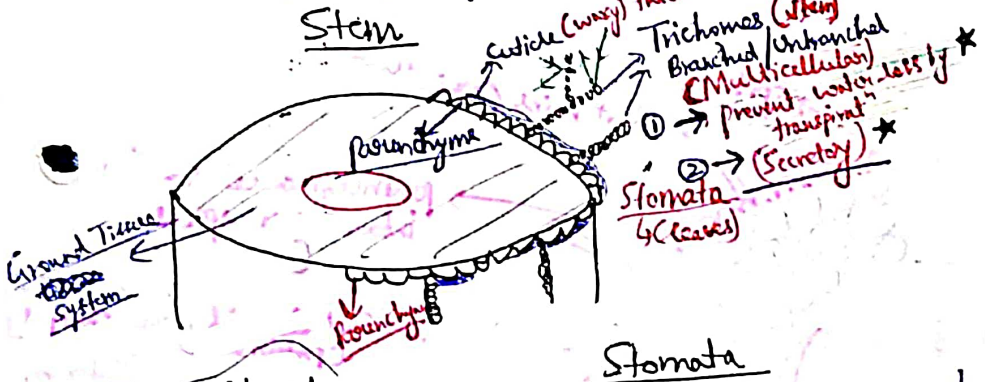
2. The Tissue System
(Str. & Locat° Basis)

1. Epidermal T.S. 2. Fundamental / Ground T.S. 3. Conducting / Vascular T.S.

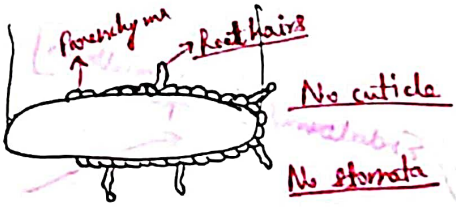
* Epidermal T.S.

→ outermost layer of 1° plant body → elongated, compactly arr. cells forming Continuous layer.
→ Single layer of Parenchyma cells usually. Cells → Small, peripheral cytoplasm + large Vacuole

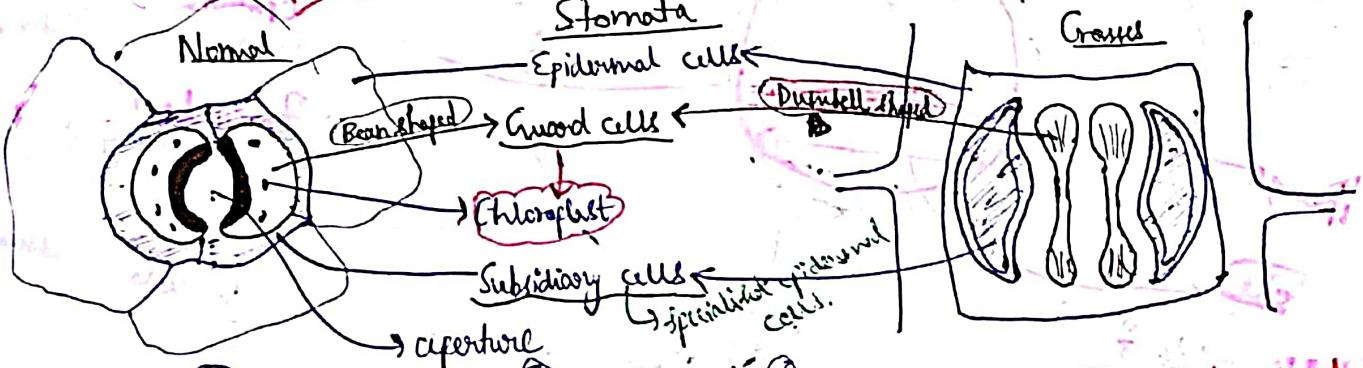
Stem



Root



Stomata



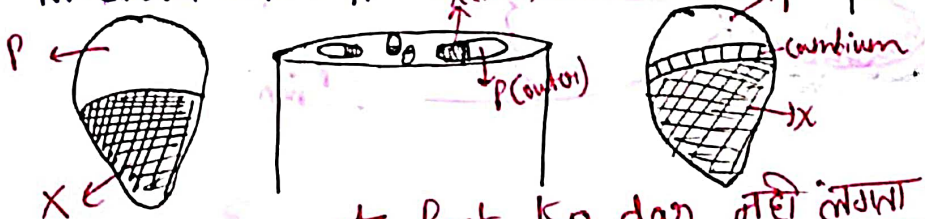
* 5. ① Aperture + ② Guard cells + ③ Subsidiary cells → Stomatal apparatus

2. Ground T.S. → Layers T.S.

Parenchyma → Cortex, pith, pericycle, Medullary rays.
Leaves → Mesophyll cells → thin walled, chloroplast cont.

3. Vascular T.S.

Stem/leaf → Conjoint arr.
- Monocot: Closed Conjoint — No cambium in b/w X & P
- Dicot: Open Conjoint — Cambium tint



Root → Radial arr.

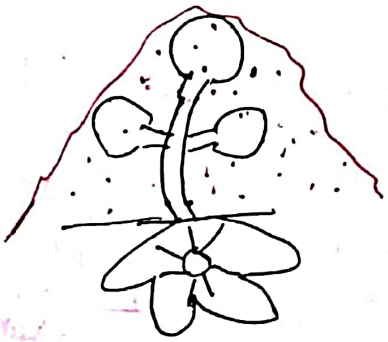
★ Root Ko dar होती जड़ों Stem को जड़ों से!
★ Roots का Protect.

Anatomy of Monocots & Dicots

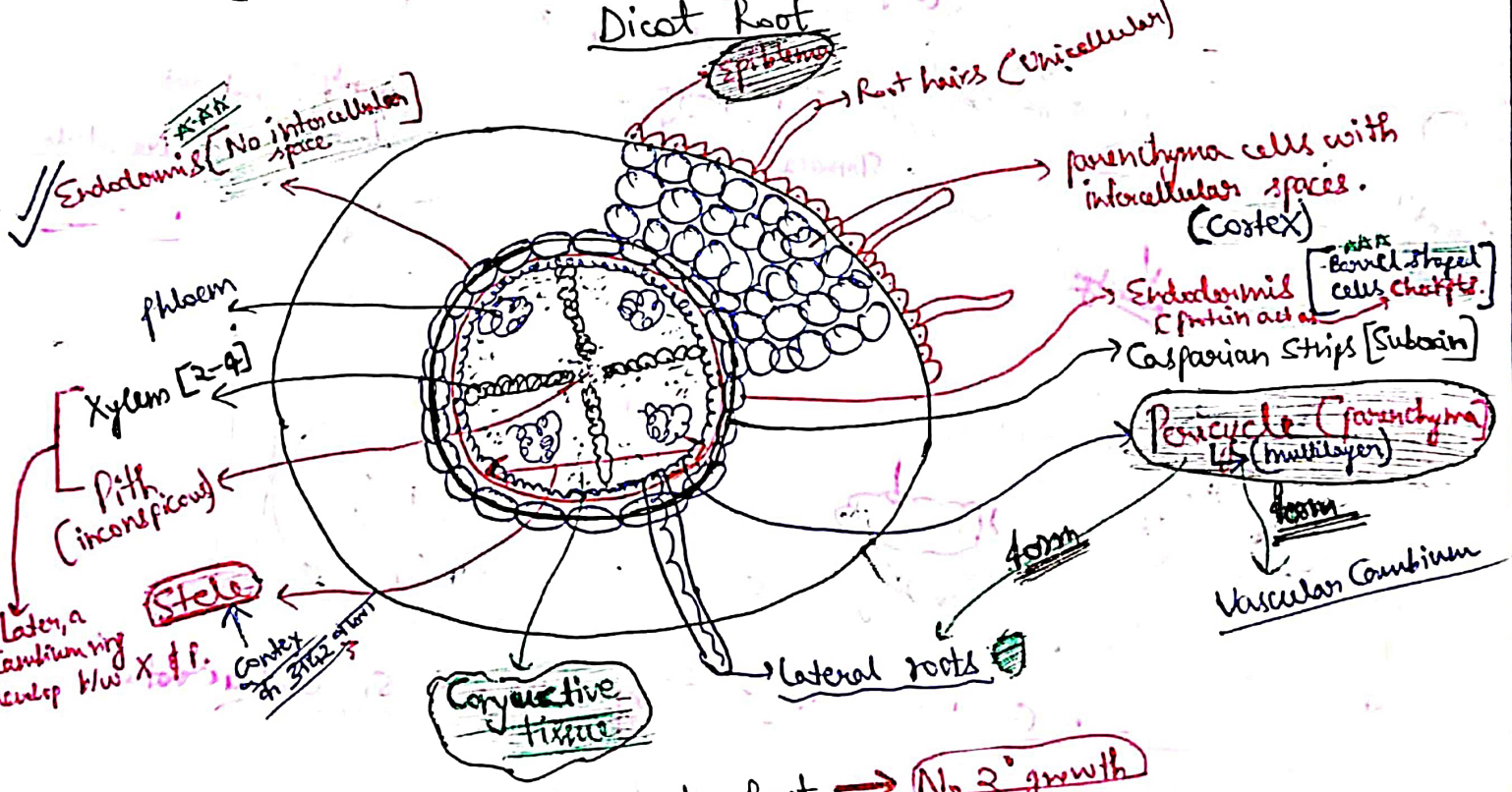
* For study of anatomy of an plant organ → T.S. of Mature zones of organ.

Dicot → 2° growth

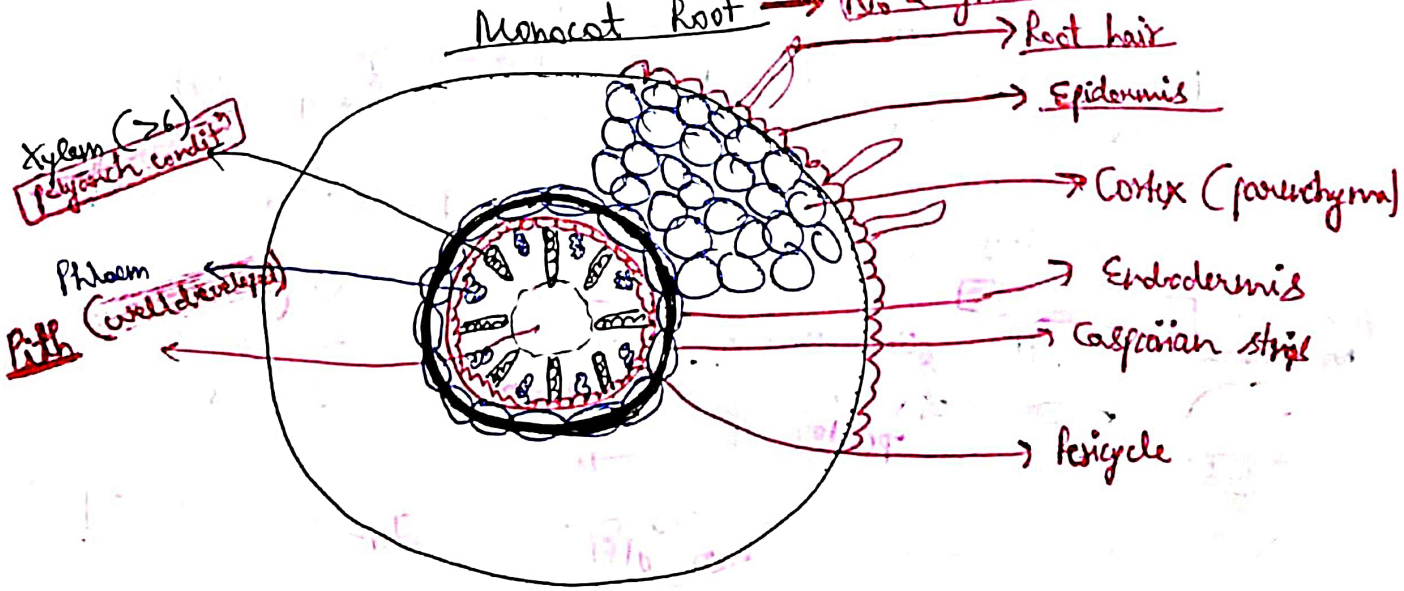
Monocot → 1° growth



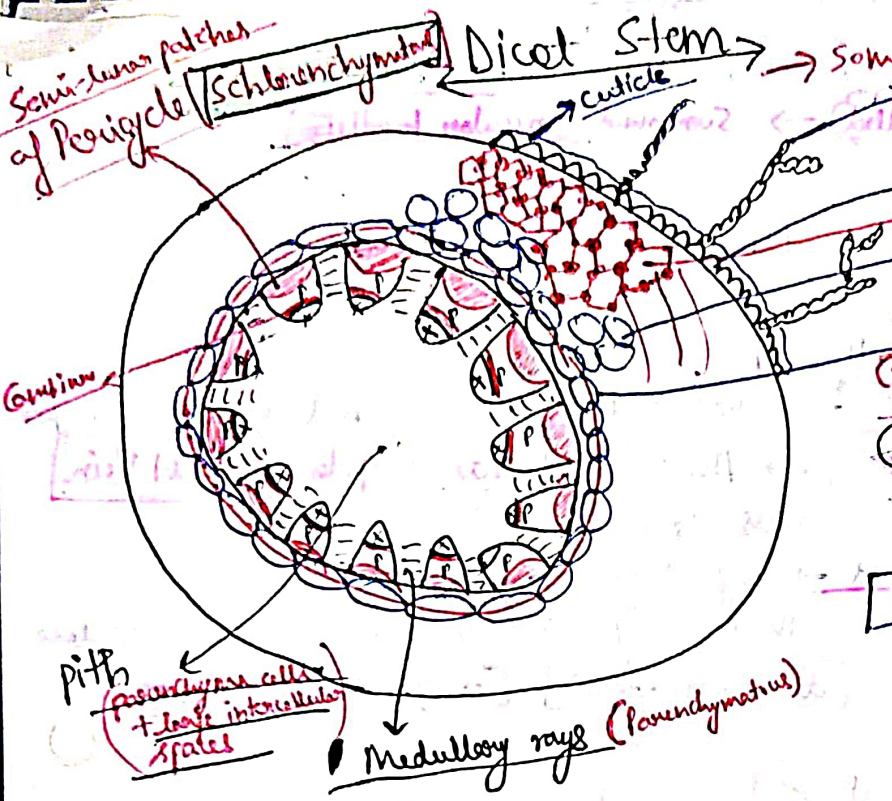
Dicot Root



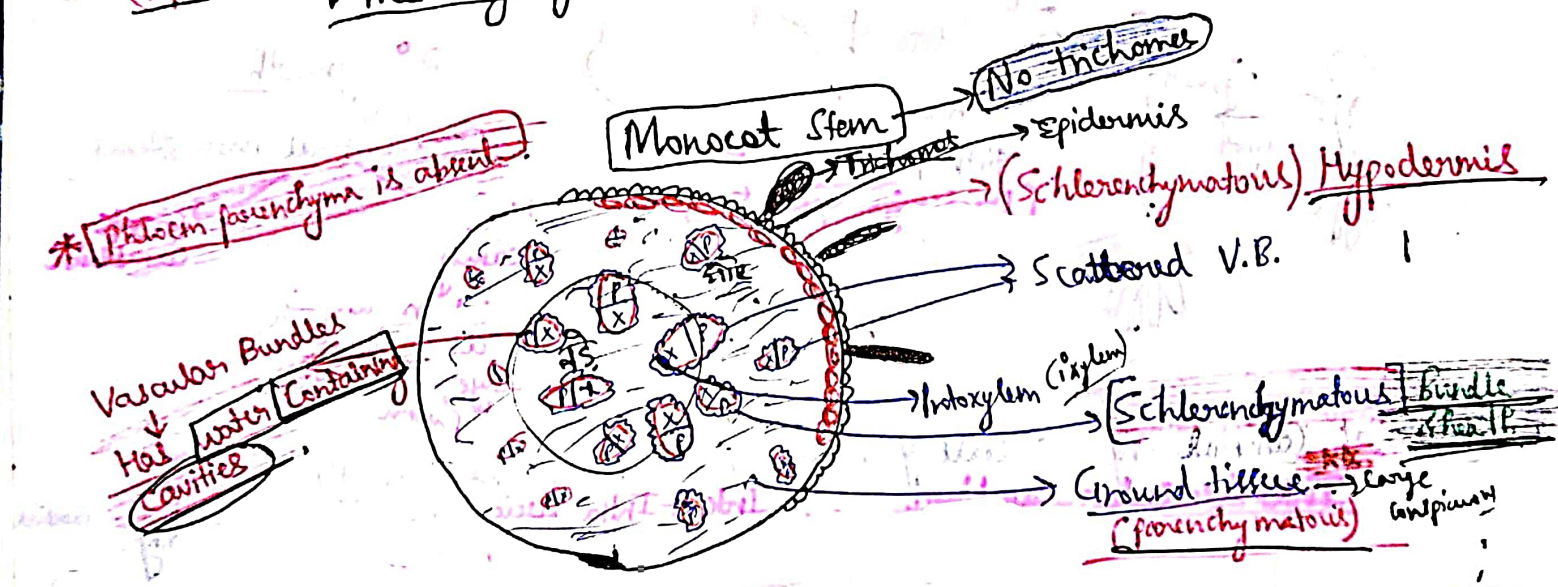
Monocot Root → No 2° growth



Dicot Stem

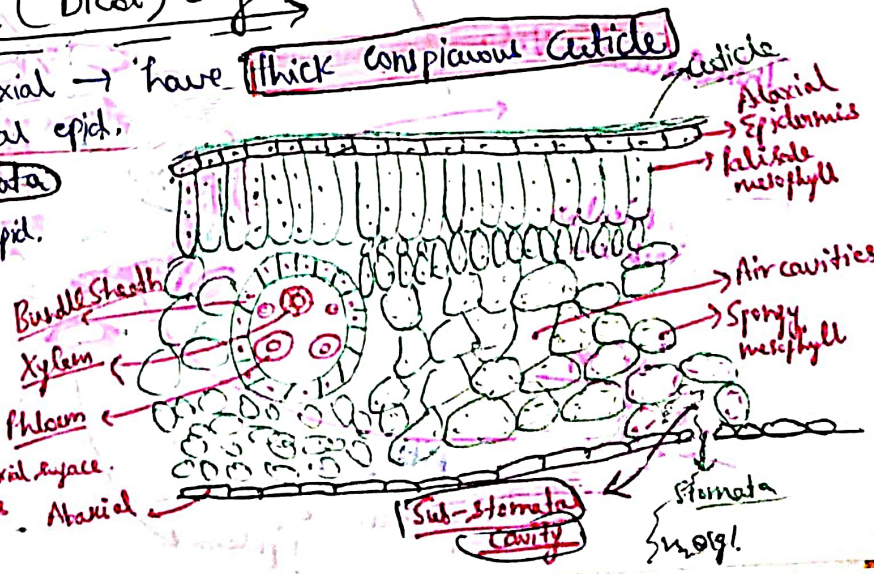


Monocot Stem



Dorsiventral (Dicot) Leaf

1. **Epidermis** → Adaxial + Abaxial → have thick conspicuous cuticle
   - ✱ More stomata on abaxial epid.
   - ✱ Adaxial → may lack stomata
2. **Mesophyll** → B/w Ada. & Abaxial epid.
   - → Has chloroplasts to do P.S.
   - → Parenchymatous cells
     - **Palisade Parench.** → Elongated, vertically arr., packed cells on adaxial side.
     - **Spongy Parench.** → oval/round → Below palisade to abaxial epidermis. → Large spaces/cavities b/w cells.



Vascular System → Veins/midrib. → Size ∝ Size of Veins

Veins → Vary in thickness in Reticulate Venation [Dicot leaves]

Bundle Sheath cells → [Thick walled] → Surround [Vascular bundles]

→ [Lignified only at centre]

Isobilateral [Monocot] leaf

① → Stomata both on adaxial & abaxial surface

② → Mesophyll → [Not differentiated] into palisade / spongy paren..

③ → No Bundle Sheath cells. ④ → Vascular Bun ⇒ extend abaxially to adaxial surface

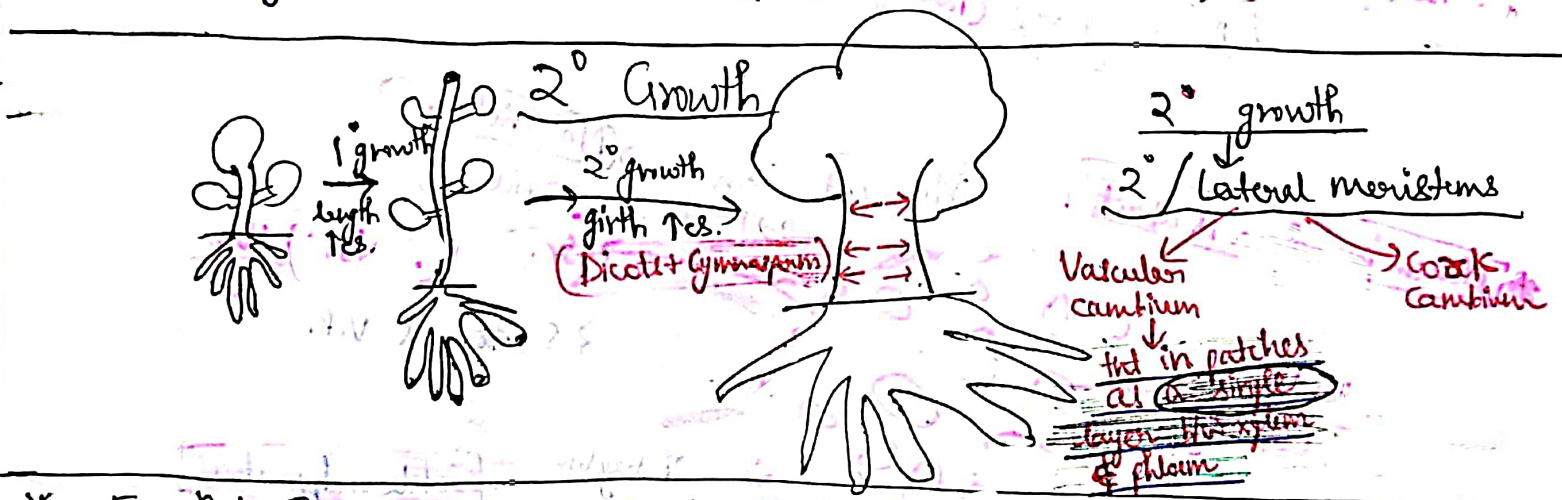
⑤ Bulliform cells → In [Grasses] → Modified [Adaxial epidermal cells] + Vein (M)

→ Large, empty, Colourless cells.

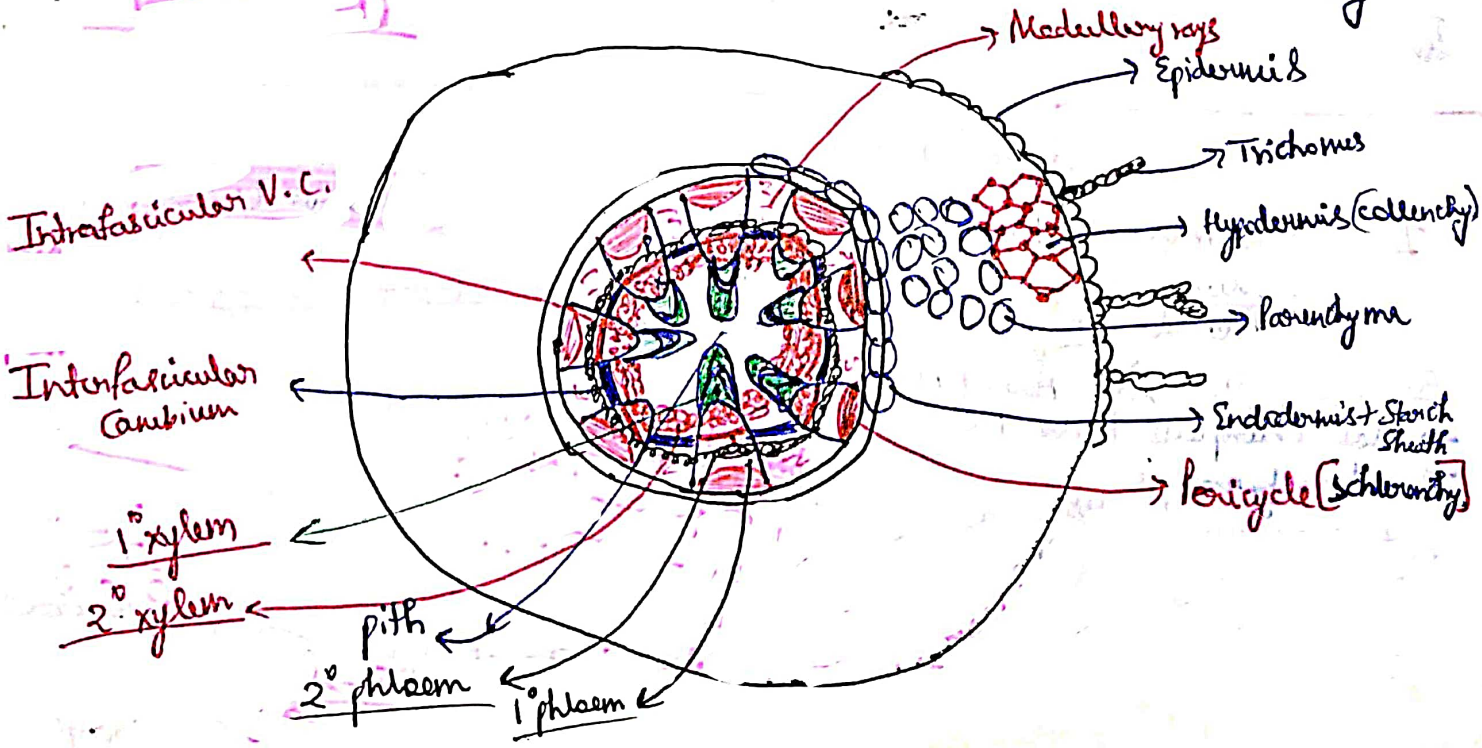
→ Absorb water → become turgid → leaf surface expand

→ Water stress → [Flaccid] → make leaf curl inwards to minimise H_2O loss.

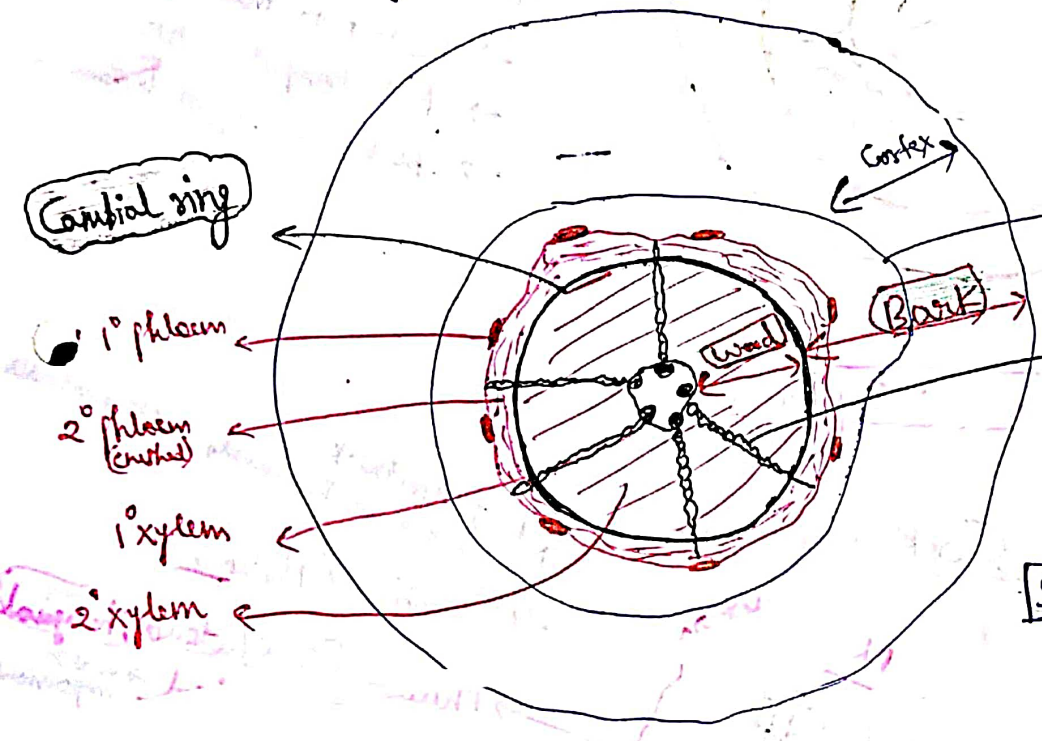
⑥ Nearly similar V.B size [due to ↑↑ venation] [except in main veins]



* Format^n of Cambial ring → cells of Medullary rays become meristematic to form Interfascicular cambium ∴ Intra + Inter fascicular Cambium → Continuous cambial ring.



* **Cambium** → More active towards Inward than outward.
  ∴ Amt. of 2° xylem > Amt. of 2° phloem.
* 1° & 2° phloem → Gradually crushed due to 2° xylem accumulat^{n}.
* 1° Xylem → More / less intact
* 2° Medullary rays → Parenchymatous cells. Narrow band formed by cambium passing through 2° xylem & 2° phloem in Radial direct^{n}.



1) 2° xylem Crushes everything outside Cambial ring & forms Bark.

Stem → Wood + Bark

Spring & Autumn Wood

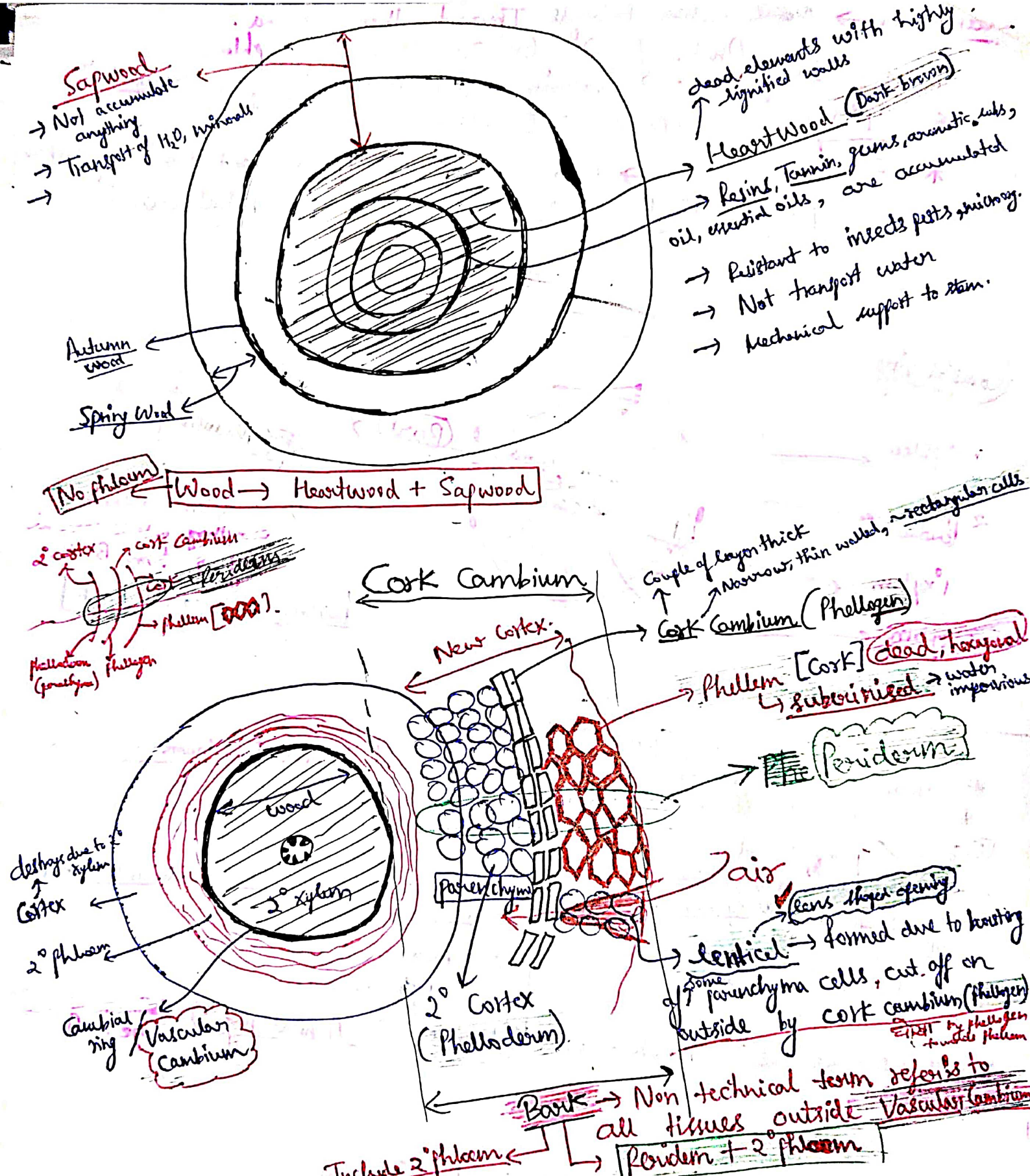
* Activity of Cambium → Under control of many ① Physiological & ② Environmental Factors.
* Temperate Condit^{n} → Climate Not Uniform throughout year.

① Early / Spring Wood
- → Cambium very active
- → Larger no. of Xylary elements with wider Vessels
- → Light in colour
- → Low density

② Autumn / Late Wood
- → Cambi. less active
- → Smaller No. of Xylary elements with Narrow vessels.
- → Darker colour
- → High density.

Woods → Appears as concentric rings (alternate) ⇒ Annual ring → Estimate of tree's age.

Heart Wood & Sapwood

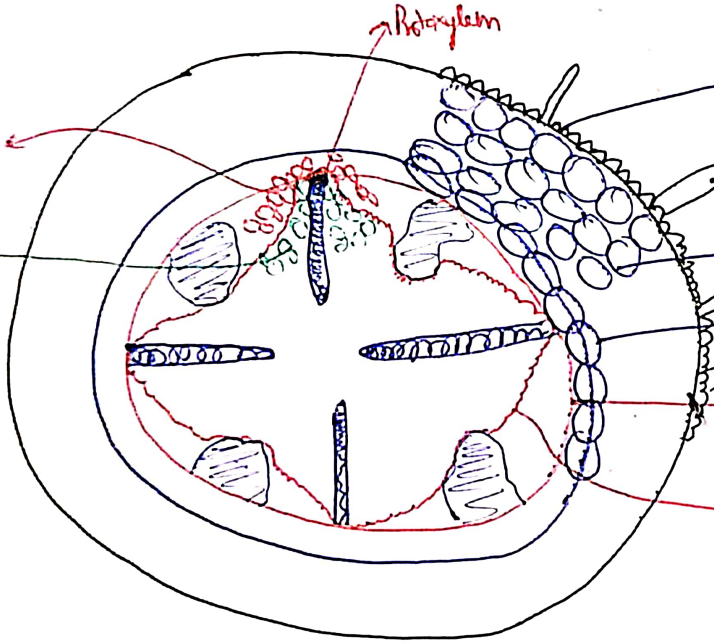

Sapwood
→ Not accumulate anything
→ Transport of H_2O, minerals
→
Autumn wood
Spring Wood
dead elements with lignified walls
Heartwood (Dark brown)
→ Resins, Tannin, gums, aromatic oils, oil, essential oils, are accumulated
→ Resistant to insects pests shrinkage.
→ Not transport water
→ Mechanical support to stem.
No phloem
Wood → Heartwood + Sapwood
2° cortex
cork Cambium
cork
Phellem [000].
Phellogen
Cork Cambium
Couple of layer thick
Narrow, thin walled, rectangular cells
Cork Cambium (Phellogen)
New Cortex
Phellem [Cork] dead, hexagonal
Suberised → water impervious
Periderm
wood
3° xylem
2° phloem
Cambial ring
Vascular Cambium
Parenchyma
air
lenticel → formed due to loosing of some parenchyma cells, cut off on outside by cork cambium (Phellogen)
Exert by phellogen towards phellem
2° Cortex (Phellodeem)
Bark → Non technical term refers to all tissues outside Vascular Cambium
Include 2° phloem
Periderm + 2° phloem
* Soft/Early Bark :→ Formed Early in season
* Hard/Late Bark :→ Towards end of season.

Secondary Growth In Roots

(F) Vascular Cambium → Completely 2° in Nature (Or)

↓

originates from tissue just below phloem bundles [pericycle]. & above protoxylem.



→ Epidermis

→ Root hair

→ Cortex

→ Endodermis

→ Stele

→ Complete, wavy, continuous Cambium ring.

↓

It becomes Circular later.